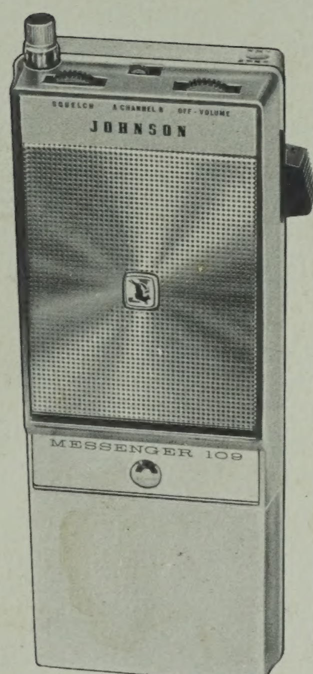
JOHNSON

MESSENGER 109

CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-109

$2.00



SERVICE MANUAL

M E S S E N G E R

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CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-109

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SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF THIS MANUAL

This service manual includes servicing and alignment instructions for the Messenger 109 Transceiver. Revision notices will be published as this unit is revised. Insert these notices in order at the back of this service manual.

1.2 FACTORY CUSTOMER SERVICE

A liaison between the customer and the factory is provided by the E. F. Johnson Company Customer Service Department. This department is available for consultation and assistance on technical problems, parts information, and availability of local and factory repair facilities.

If it is necessary to write to the Customer Service Department, please include a complete system diagram. Especially important are accessories used, attachments and modifications effected during or after installation.

For any of the above requirements contact:

E. F. Johnson Company
Customer Service Department
Waseca, Minnesota 56093

1.3 FACTORY RETURNS

Normally, repair service is available locally through authorized Johnson Citizens Band Radio Service Centers; a list of these service centers is available upon request from the factory Customer Service Department. Do not return any equipment to the factory without authorization from the Customer Service Department.

1.4 PURCHASE OF PARTS

The authorized Johnson Service Centers stock commonly needed replacement parts. If a part is not available locally it may be ordered from the Customer Service Department. When ordering please supply the following information:

Model number of the unit
Serial number of the unit
Description of the part
Part number of the part

1.5 DESCRIPTION

The Messenger 109, Model 242-109-1/23, is a 3 watt DC power input to the final stage Citizens Band handheld transceiver. Two-channel capabilities are standard. The basic transceiver weighs 30 ounces and is completely solid state. Supply voltage to operate the transceiver is provided by a rechargeable battery pack or by an accessory pen cell battery pack. The transceiver has provision for mobile mounting, (see section 2. 6) and may be used with an external 50 ohm antenna and external speaker.

SECTION 2
SPECIFICATIONS

2.1 GENERAL

Frequency Range	26.965 - 27.255 MHz
Channels	Two
Dimensions of Enclosure	8-1/2" high x 3-5/16" wide x 1-13/16" deep
Unit Weight	Approximately 30 oz.
Shipping Weight (1 unit)	Approximately 3 lbs.
Microphone	Built - in 2 - 3/4" dynamic speaker/microphone
Circuitry	14 transistors, 8 diodes, and a thermistor
Compliance	FCC Type Accepted Rule Part 89, 91, 93 and 95 (D) DOT Type Approved RSS 136

2.2 RECEIVER

(All microvolts are measured at the antenna terminals and the numbers are 1/2 the microvolts measured into a 50 ohm 6 dB pad).

Sensitivity	8 dB minimum at 0.5 microvolts
Selectivity	6 kHz bandwidth at -6 dB 30 kHz bandwidth at -60 dB
Frequency Control	±0.005% crystal from -30°C to +60°C
Spurious Rejection	50 dB except image of 12 dB
Antenna Impedance	50 ohms
Audio Output Power	0.13 watts minimum at 0.5 microvolts
Speaker Impedance	16 ohms
Squelch Range	6 microvolts minimum
Squelch Sensitivity	2 dB or less signal change for 40 dB of quieting at 1 microvolt
Intermediate Frequency	455 kHz
AGC Characteristics	20 ±3 dB roll-off from 500 to 0.5 microvolts
Noise Limiting	Series-type, automatic threshold adjustment and IF clipping
Circuitry	All transistor single conversion

2.3 TRANSMITTER

Emission	6A3
Frequency Control	±0.005% crystal from -30°C to +60°C
DC Power Input	3 watts maximum at 12.6 VDC
RF Power Output	1.6 watts minimum at 12.6 VDC
RF Spurious and Harmonic Attenuation	Better than FCC and DOT requirements
Output Impedance	50 ohms
Audio Input Impedance	1000 ohms
Audio Frequency Response	±3 dB 600-4000 Hz

Modulation	70% minimum upward
Circuitry	All transistor solid state

2.4 POWER SOURCE REQUIRED

12.6 VDC input
Battery life 8 hours with standard duty
Cycle with nickel-cadmium battery pack

80% squelch:	0.024 ampere
10% receive:	0.039 ampere
10% transmit:	0.400 ampere

Battery life is 2.25 hours when using 8 Ever-ready E91, size AA pen cells on standard duty cycle.

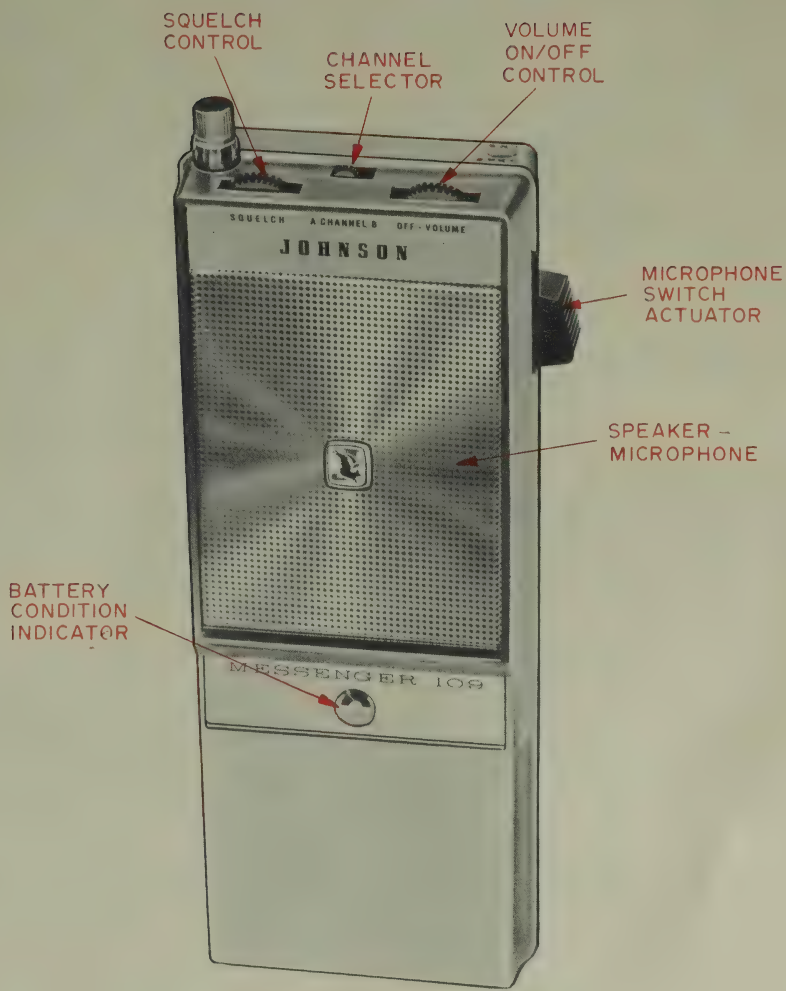
2.5 POWER SOURCE SUPPLIED

239-128-1	Rechargeable nickel-cadmium batteries with built-in charger and provision for external charging.

2.6 ACCESSORIES

239-130-1	Pen cell battery case
239-132-1	* Base charger
239-133-1	* Mobile rack with charger
239-133-2	* Mobile rack without charger
251-834-1	Carrying case
251-835-1	Holster

* For installation and servicing information, see the operating manuals covering these accessories.



FRONT VIEW
FIGURE I

SECTION 3
CIRCUIT DESCRIPTION

3.1 GENERAL

You can become familiar with the transceiver by studying the schematic diagram found at the back of this manual, the simplified diagrams, and the block diagram, Figure 7 while following the circuit description.

3.2 SWITCHING (SEE FIGURE 2)

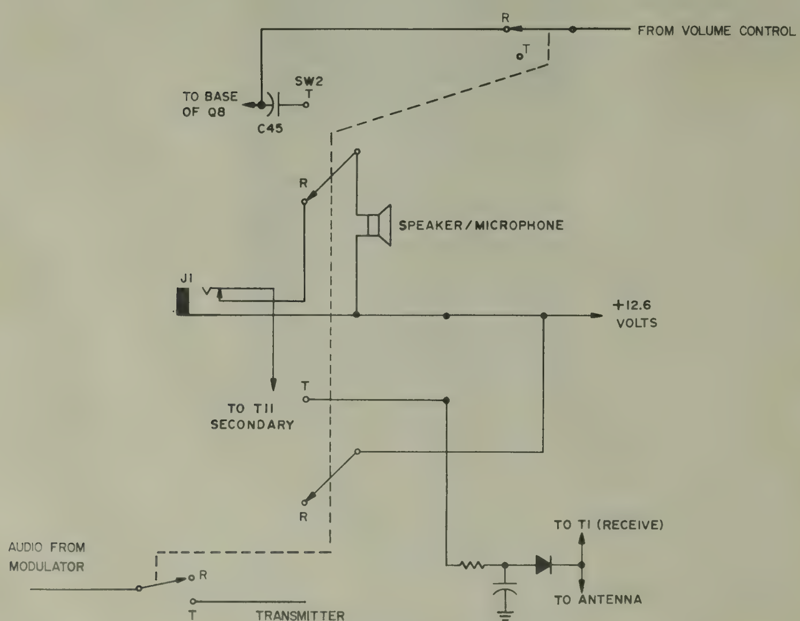
A diode is used for switching the antenna from receive to transmit. The transmit keying switch (SW2) switches the B+ from receive to transmit, see Figure 2, Switching Simplified Schematic.

3.3 RECEIVER RF SECTION

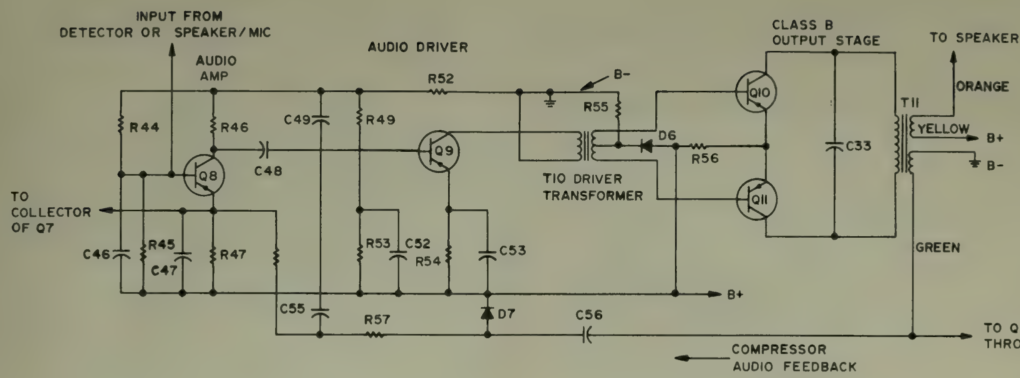
In receive, the RF signal from the antenna passes through a Pi network and is coupled to T1 by C72. T1 provides impedance transformation. The first RF amplifier, Q1, raises the RF signal level. T2 provides RF tuning and couples the signal to the base of the mixer, Q2. The mixer receives an emitter input from T3, the oscillator transformer. The oscillator operates at 455 kHz below the carrier.

3.4 IF

The output of the mixer is applied to a four section bandpass filter tuned for 455 kHz. The output of the filter is coupled to the base of Q4. Transistors Q4 and Q5 raise the 455 kHz signal to a level suitable for detection.



SIMPLIFIED SCHEMATIC
TRANSMIT/RECEIVE SWITCHING
FIGURE 2



SCHEMATIC
AUDIO / MODULATOR
FIGURE 3

3.5 AUDIO (See Figure 3, Audio Schematic)

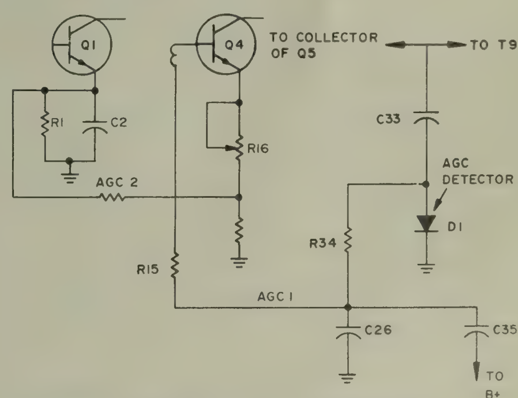
The output of the second IF amplifier is applied to a detector and noise limiter network. Noise limiter action clips off the noise spikes. Detector action detects a change in amplitude and develops the audio. The audio output from this network is coupled by C39 to the volume control, R37. From the movable contact of the volume control the audio is coupled by C44 to the base of the first audio amp, Q8. The amplified audio from Q8 is amplified by driver Q9 and applied to T10. Driver transformer T10 couples the audio to the Class B audio output stage consisting of audio power transistors Q10 and Q11. The audio output transformer, T11, has two secondaries. One secondary (orange and yellow leads) provides audio power to drive the speaker. The other secondary (green lead and B-) provides modulating power for the transmitter.

3.6 AUDIO COMPRESSOR (See Figure 3, Audio Schematic)

Constant modulation during transmit is maintained by detected audio feedback from T11. Audio from the green lead of T11 is coupled to a rectifier filter network by C56. The rectifier filter consists of D7, R57 and C55. The output of this network is negative DC and is applied to the emitter of Q8. The compressor adjusts from a high level mic input by producing a higher level of negative DC. The DC adjusts the emitter voltage of Q8 and reduces its gain.

3.7 AGC (See Figure 4, AGC Line)

A portion of the second IF output is coupled by C33 to a rectifier filter network consisting of D1, R34 and C26. This network develops a negative going AGC voltage that is applied directly to the base of Q4 and indirectly to the base of Q1. Negative going AGC voltage, the result of a stronger received signal at the antenna, causes a decrease in the base voltage of Q4 and reduces its gain. This also causes the emitter voltage of Q4 to decrease. The emitter of Q4 is connected to the base of Q1 through R13 and the secondary of T1. Any change in the emitter voltage of Q4 results in a change in the base voltage of Q1.



SIMPLIFIED SCHEMATIC
AGC LINE
FIGURE 4

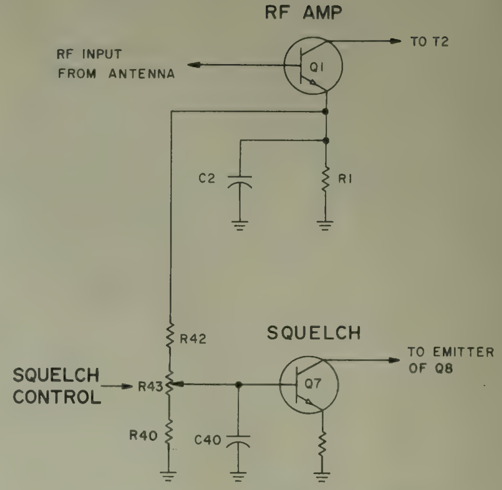
3.8 SQUELCH (See Squelch Simplified Schematic, Figure 5)

The squelch circuit consists of a squelch amplifier, Q7, and squelch control potentiometer R43. R43 changes the operating point of Q7, or simply changes the state of Q7 to conducting more or conducting less. The conduction of Q7 determines the emitter voltage of the first audio amp, Q8.

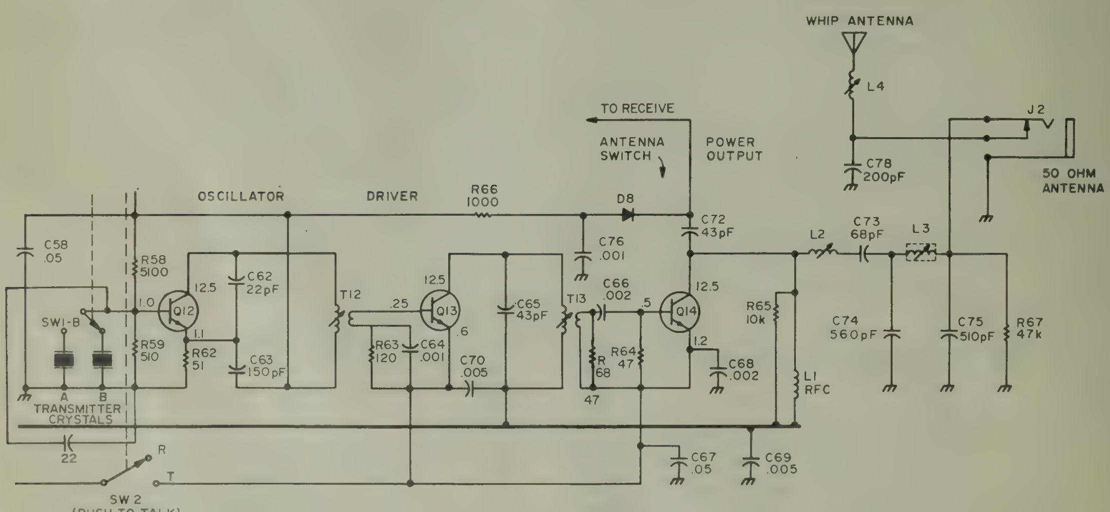
Assume that R43 is set so that Q7 is turned on and Q8 is turned off. In this condition the audio is disabled. When an RF signal is received, the emitter voltage of Q1 goes in a slightly negative direction. This causes Q7 to turn off (depending on the setting of R43) and raises the emitter voltage of Q8. When the emitter voltage of Q8 reaches the forward biased value, it turns Q8 on and enables the audio.

3.9 TRANSMITTER (See Transmitter Simplified Schematic, Figure 6)

The transmitter consists of an oscillator op-



SIMPLIFIED SCHEMATIC
SQUELCH CIRCUIT
FIGURE 5



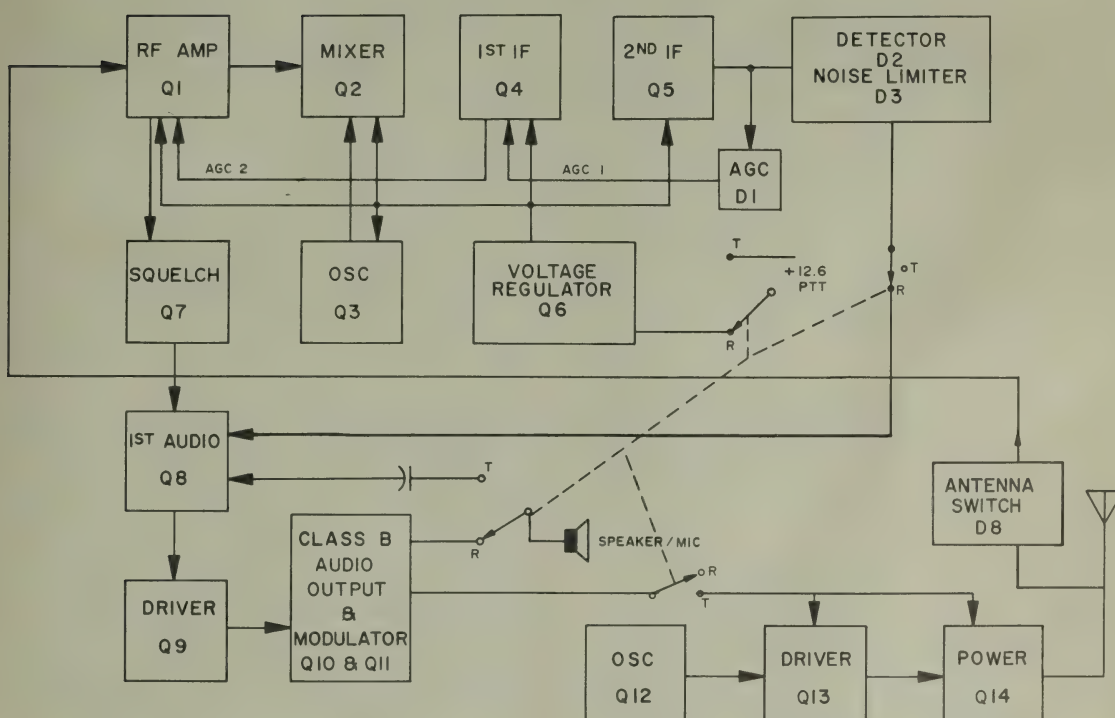
TRANSMITTER SCHEMATIC
RF SECTION
FIGURE 6

erating at the crystal frequency, driver and power output stage. When the RTT (push-to-talk) switch is depressed, +12.6 volts is applied to the oscillator stage; B- and audio are applied to the driver and PA. The oscillator (Q12) output level is raised by the driver, Q13, and applied to the power output stage is designed to operate at a DC input power level of 3 watts.

The power output stage drives an external 50 ohm antenna, connected to J2, or the self contained whip antenna.

3.10 BATTERY CONDITION METER

The relative condition of the battery pack is indicated by an expanded scale voltmeter located on the front of the transceiver. The meter scale is divided into three segments, green, silver and red. Green indicates the battery pack is usable. Silver indicates the battery pack is at 11 volts and in need of recharging. Red indicates the battery pack voltage is less than 11 volts, or below the level required to operate the transceiver.



MESSENGER 109
BLOCK DIAGRAM
FIGURE 7

SECTION 4
SERVICING

4.1 TRANSISTOR TROUBLE SHOOTING

4.1.1 GENERAL

The following information is intended to aid troubleshooting and isolation of transistor circuit malfunctions.

4.1.2 TRANSISTOR OPERATING CHARACTERISTICS

For all practical purposes the transistor base-emitter junction and the transistor base-collector junction can be considered to be diodes. For the transistor to conduct collector to emitter its base-emitter junction must be forward biased in the same manner as a conventional diode. In a germanium transistor the typical forward biased junction voltage is 0.2 to 0.4 volts. A typical silicon transistor will have forward biased junction voltage of 0.5 to 0.7 volts. When collector current is high the base-emitter voltage of both germanium and silicon transistors increases from 0.1 to 0.2 volts. The base-emitter bias voltage in the forward biased condition is then 0.4 to 0.5 volts for a germanium transistor and 0.7 to 0.9 volts for a silicon transistor. High current silicon transistors may go up to 2 volts under load.

A high impedance DC voltmeter is usually the only measuring instrument required for determining the operating status of an in-circuit transistor. The meter is used to measure the transistor bias voltages. See Figure 8 for the correct voltmeter connections for measuring in-circuit transistor bias.

4.1.3 IN-CIRCUIT TRANSISTOR TESTING

a. Refer to Figure 8 for test connections.

b. Measure the emitter voltage. Compare your measurement to the voltage listed on the schematic diagram. A correct emitter voltage reading generally indicates that the transistor is working properly. If you are in doubt as to the condition of the transistor after measuring the emitter voltage, proceed to the following tests.

c. Measure the base-emitter junction bias. The voltage measured across a forward biased junction should be approximately 0.3 volts for a germanium transistor and 0.6 volts for a small signal silicon transistor.

d. Check for amplifier action by shorting the base to the emitter while monitoring the collector voltage.* The transistor should cut off (not conduct emitter to collector) because the base-emitter bias is removed. The collector voltage should rise to near the supply level. Any difference is the result of leakage current through the transistor. Generally, the smaller the leakage current the better the transistor. If no change occurs in the collector voltage when the base-emitter junction is shorted the transistor should be removed from the circuit and checked with an ohmmeter or a transistor tester. The following section describes the technique for testing transistors out of the circuit with an ohmmeter.

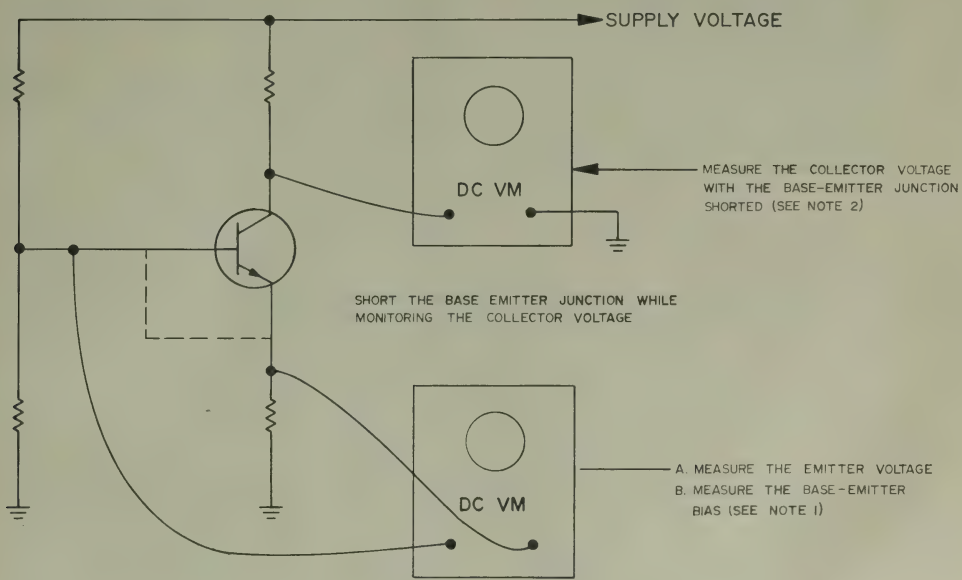
* Not recommended for high level stages under driving conditions.

4.1.4 OUT OF CIRCUIT TRANSISTOR TESTING

Only high quality ohmmeters should be used to measure the resistance of transistors. Many ohmmeters of both VOM and electronic types have short circuit current capabilities in their lower ranges that can be damaging to semiconductor devices. A good "rule of thumb" is to never measure the resistance of a semiconductor on any ohmmeter range that produces more than 3 milliamperes of short circuit current. Also, it is not advisable to use an ohmmeter that has an open circuit voltage of more than 1.5 volts. A current limiting resistor may be used in series with ohmmeter probes to make the lower ranges safe for measuring semiconductor resistances. If a current limiting resistor is used its value must be subtracted from the ohmmeter reading. The following section describes a method for determining the short circuit current capabilities of ohmmeters.

4.1.5 HOW TO DETERMINE OHMMETER CURRENT

When the ohmmeter test probes are shorted together (measuring the forward resistance of a diode or the base-emitter junction of a transistor amounts to the same thing) the meter deflects full scale and the entire battery voltage appears across a resistance that we will designate as R1. The current through the probes is the battery voltage divided by the resistance of R1. A very easy method is available for determining the value of R1. Look at the exact center of the ohmmeter scale. Your reading is the value of R1 on the Rx1 range.



TEST CONNECTIONS FOR
IN-CIRCUIT TRANSISTOR TESTING
FIGURE 8

NOTE 1:

Enough loop current is present in the leads of some electronic voltmeters to destroy transistors if measurements are made directly across transistor junctions. If an electronic voltmeter is used, perform the above measurements with respect to the circuit voltage common.

NOTE 2:

If the collector voltage is measured with a VOM the meter leads may be connected directly across the collector resistor. The difference between the supply voltage and the collector voltage will then be indicated directly on the VOM.

NOTE 3:

Be careful when connecting test leads to in-circuit transistors. Operating transistors can be ruined by shorting the base to the collector and in some circuit configurations, the emitter to ground.

The only other unknown required to calculate the short circuit current of an ohmmeter is the internal battery voltage. Let's take a well known meter that has a center scale reading on the ohms scale of 4.62 and a battery voltage of 1.5 volts. Its short circuit current can be calculated by using Ohm's Law. Dividing 1.5 volts by 4.62 ohms equals a short circuit current of 324 mA on the Rx1 range. Obviously, the Rx1 range of this meter cannot be used to measure the resistance of semiconductors. When the value of R1 is known for the Rx1 range it can then be determined for any range by multiplying R1 by the multiplier value of the range. The value of R1 for the Rx10 range of a meter with an R1 value on the Rx1 range of 4.62 ohms is 4.62 x 10 or 46.2 ohms. The short circuit current on the Rx10 range can then be calculated: 1.5 volts divided by 46.2 ohms equals 32.5 mA. By using this method, the lowest safe range for measuring semiconductor resistance may be determined for any ohmmeter.

Remember that you should not measure any semiconductor resistance on any ohmmeter range which produces more than three milliamperes of short circuit current.

The following table indicates the results that should be obtained from operational transistors measured out of the circuit.

TABLE I
TYPICAL TRANSISTOR JUNCTION RESISTANCES (MEASURED OUT OF CIRCUIT)

Transistor Type		Ohmmeter Connections + lead	- lead	Resistance in ohms
Germanium PNP	Power	Emitter	Base	30 to 50 ohms
		Emitter	Collector	Several hundred
	Small Signal	Emitter	Base	200 to 250 ohms
		Emitter	Collector	10 k to 100 k ohms
Silicon PNP	Small Signal	Emitter	Base	10 k to 100 k ohms
		Emitter	Collector	Very high (Might read open)
Silicon NPN	Power	Base	Emitter	200 to 1000 ohms
		Collector	Emitter	High; often greater than 1 Megohm
	Small Signal	Base	Emitter	1 k to 3 k ohms
		Collector	Emitter	Very high (Might read open)

4.2 GENERAL SERVICING INFORMATION

4.2.1 VOLTAGE MEASUREMENTS

Both NPN and PNP transistors are used in the Messenger 109. All voltages are measured with respect to B-.

4.2.2 SOLDERING

The Messenger is constructed on a double sided printed board with plated through holes. If a ground pad is damaged, the solder connection must be made at the top of the board. Use an iron from 30 to 50 watts. High temperatures applied for a very short period of time are easier on printed circuit boards than inadequate heat which must be applied for a long period of time. We recommend use of some form of vacuum bulb desoldering device such as a "Solder Sipper". The "Solder Sipper" may be obtained from the following address:

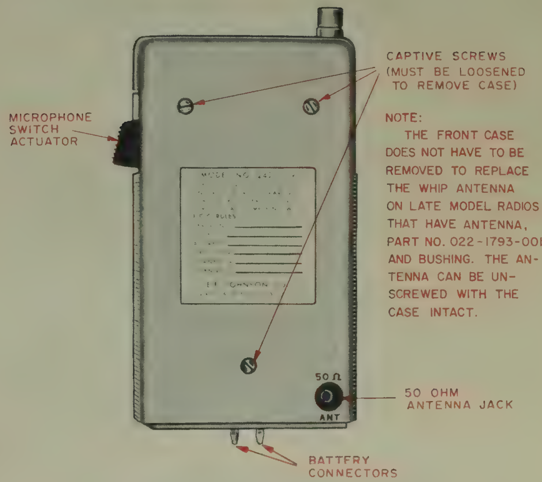
Solder Sipper Company
1527 Faris Avenue
St. Louis, Missouri 63133

4.2.3 REMOVING THE CASE (See Figure 9)

a. Loosen the screw at the bottom of the battery pack. Pull the battery pack straight away from the transceiver.

b. Place the transceiver front down on a flat surface. Unscrew the three captive screws on the back of the transceiver until they are free.

c. Components mounted on the front panel are wired to the beige rear section of the unit. Remove the front carefully to avoid breaking these wires. Lift the front away from the back, lower section first. Then lift the front up and away from the back, to clear the controls at the top of the unit.



REAR VIEW
FIGURE 9

4.2.4 REMOVING THE CIRCUIT BOARD (See Figure 10)

a. Unscrew the transmit switch actuator screw. Pull the actuator up and away from the transmit switch.

b. Disconnect the following wires: black and red power leads, and unsolder the L4 lead from the whip antenna connector.

c. Unscrew the whip antenna.

d. With a screw starter (we recommend a Hunter H-10M) remove the screws pointed out in Figure 10.

e. Gently lift the circuit board straight up and away from the case.

f. To reinstall the circuit board, reverse the process from steps e through a.

4.2.5 CHANGING THE WHIP ANTENNA (See Figure 10)

a. Remove the top half of the case.

b. To remove the whip, simply unscrew it.

c. Install the new whip and refasten the top cover of the transceiver.

4.3 RECHARGEABLE BATTERY INFORMATION

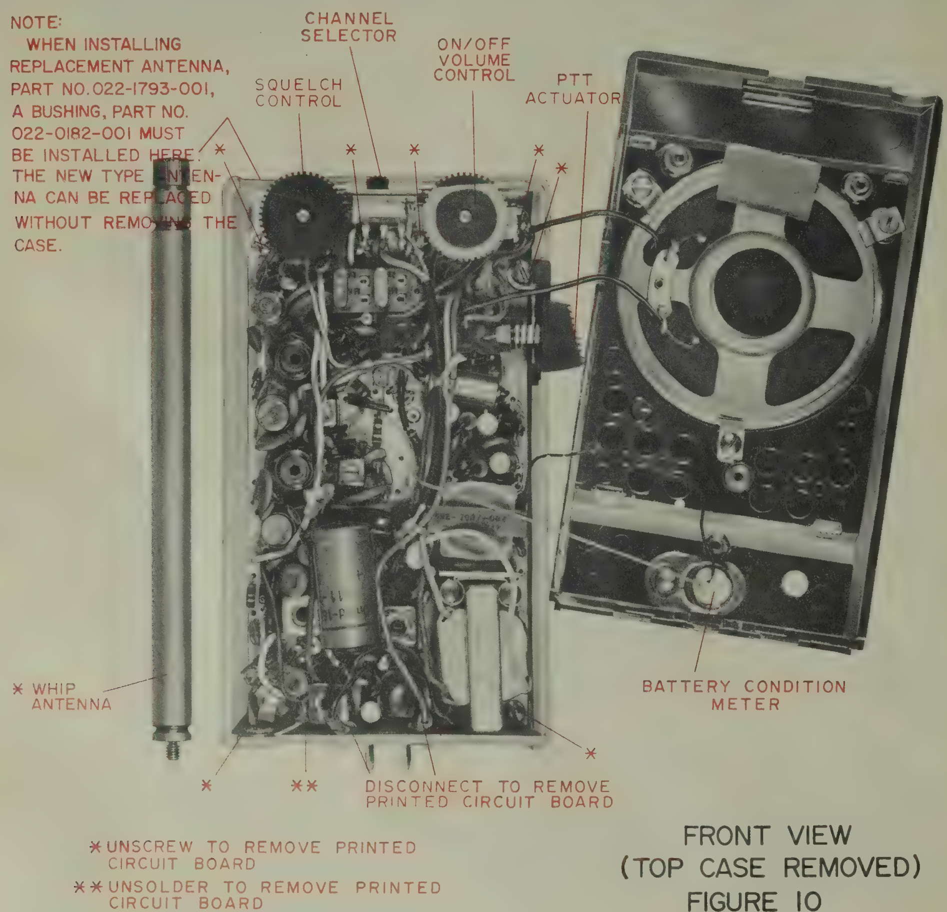
4.3.1 GENERAL

Rechargeable batteries (PN#503-0002-001) used in the transceiver are rated at 500 mA hours at from about 55°F to 100°F. Normally 16 hours charging time is required to charge a fully discharged battery pack. We consider the battery to be discharged when the voltage drops to 11 volts. A fully charged battery should be expected to last for approximately 8 hours at the 80%-10%-10% duty cycle described in Section 2.4. The duty cycle the transceiver is operated on determines the hours the battery can supply enough current to operate the transceiver. Obviously, if the operator transmits one-half of his operating time, the battery life is going to be greatly reduced.

Temperature extremes can shorten battery capacity. At 0°F (-18°C) battery capacity is about 350 mA.

The rechargeable battery can be operated over the following temperature ranges:

Charge:
+32°F to +113°F
Discharge:
-40°F to +113°F



FRONT VIEW
(TOP CASE REMOVED)
FIGURE 10

Extended overcharge or overdischarge at temperatures higher or lower than those indicated on the temperature range chart will damage the battery.

The battery can be stored over a temperature range of -40°F to +40°F. Battery life will be increased if any long term storage (for several months) is done at +70°F or lower. Cold storage offers a definite advantage. Batteries stored for a long period of time should first be recharged fully before use.

The following test should be performed on batteries that are suspected of being faulty:

a. Charge the battery pack for 16 hours.

b. Connect a 250 ohm resistor across the + and - terminals of the battery pack. With this load the battery should take approximately 10 hours to discharge to a level of 11 volts. If the batteries fail this test, the recharging circuit should be investigated. If the recharger works normally, the batteries should be replaced.

4.3.2 RECHARGING CIRCUIT

The typical charging current supplied by the recharger full wave bridge rectifier is 45 mA. This current must be checked to determine the condition of the recharger. The following schematic (Figure 11) shows the connections required for measuring the charging current.

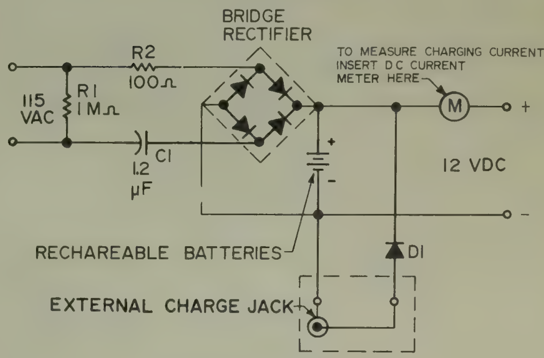
4.3.3 REPLACING RECHARGEABLE BATTERIES (See Figure 12)

a. Disconnect the battery pack from the transceiver by unscrewing the screw located at the bottom of the rechargeable battery pack.

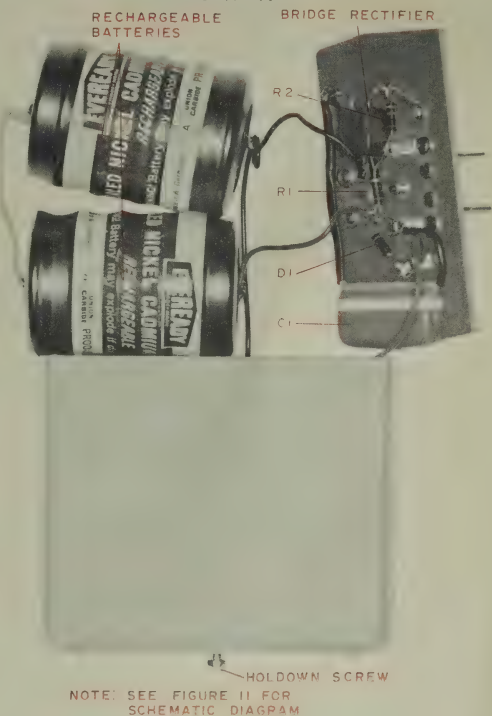
b. Disconnect the battery pack by pulling it straight away from the transceiver.

c. Unscrew the screw adjacent to the AC power prongs at the top of the battery pack. Pull the board up and slide the batteries out.

NOTE: The batteries are connected in series. Carefully note the wiring connections before doing any unsoldering.



BATTERY PACK RECHARGING CIRCUIT
FIGURE 11



RECHARGEABLE BATTERY PACK
FIGURE 12

4.4 RECEIVER SERVICING

4.4.1 GENERAL

This section covers receiver trouble isolation procedures. If a transistor seems to be faulty, refer to Section 4.1, Transistor Troubleshooting.

4.4.2 TEST INSTRUMENTS REQUIRED

NOTE: Equivalent or superior equipment may be substituted.

a. Power Supply, 11 to 14 VDC regulated, Hewlett-Packard 6201A. (fully charged batteries can be used)

b. Oscilloscope - Modified Heath IO-12

c. AC-VTVM - Heath Model AV-3

d. RF Signal Generator - 0.455 to 50 MHz with an attenuated output of 1 microvolt to 1 volt.

The modulation capability should be 1000 Hz at 30%. Hewlett-Packard 606A with 6 dB pad.

e. Audio Generator - 100 Hz - Heath Model IG-72.

f. VTVM-Heath IM-11 with RF probe.

g. 50 ohm 6 dB pad - connected to the output of the signal generator for troubleshooting and alignment purposes.

4.4.3 TEST INSTRUMENT CONNECTIONS (See Figures 13 and 14)

a. Connect the test instruments as illustrated in Figure 13.

b. Construct a signal generator cable as illustrated in Note 1 of Figure 13.

c. If a DC power supply is not available you may use a fully charged battery pack for servicing and alignment.

d. We recommend the use of a speaker load with provisions for switching between an external speaker and a resistive 16 ohm load. One may be constructed as shown in Figure 14.

4.4.4 PRELIMINARY TEST

a. Check +9 volt regulated line. If this is missing the receiver will be completely inoperative.

b. If the +9 volts regulated is missing, check the following components: Q6, D5, C43 and R38.

4.4.5 PRELIMINARY RECEIVER TEST

a. Set the signal generator for 3 microvolts output (1.5 microvolts to the transceiver antenna terminal) on the customer's operating frequency. If the Messenger has two sets of receive crystals installed, use the channel nearest channel 11 for the following checks. Set the generator's modulator for 1000 Hz and 30%.

b. Insert a DC current meter between the red + lead and the power supply.

c. Turn the transceiver on.

d. Check the receiver current drain:
   1. Conditions: Squelch maximum ccw
      Volume maximum cw
      Signal 3 μV and modulated at 1000 Hz
      Current drain 120 to 125 mA typical

   2. Disconnect the signal generator and perform the following DC current measurement.
      Conditions: Squelch maximum ccw
      Volume maximum cw
      No signal
      Current drain 24 to 28 mA typical

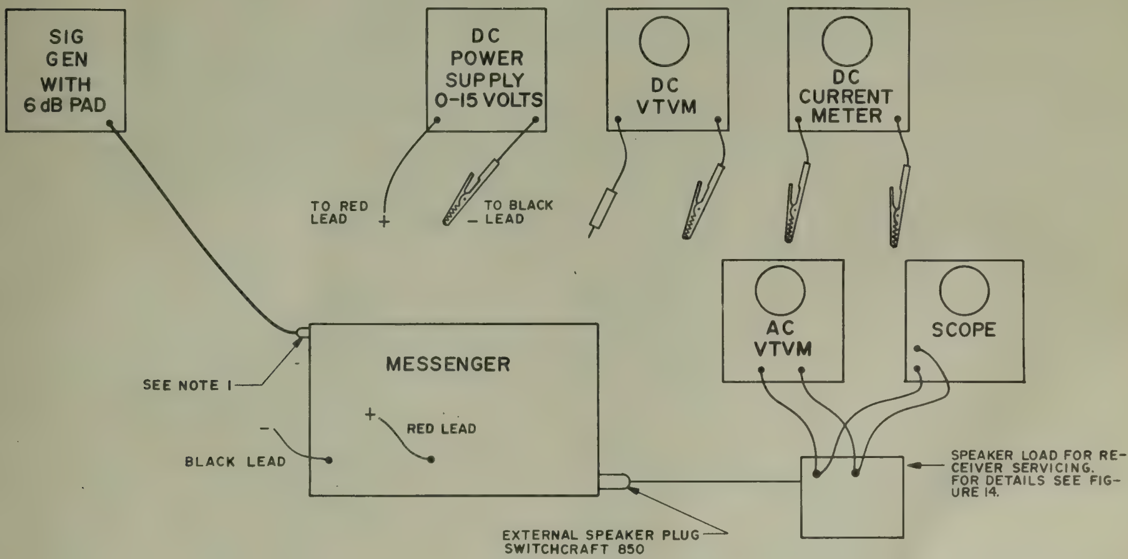
e. Set the output of the signal generator to 1 microvolt modulated 1000 Hz at 30%. There should be at least +5 dB of audio (1.4 VAC) at maximum volume control setting across the speaker load as indicated on the AC-VTVM. The receiver specifications indicated in Section 2 should be obtained.
If the above conditions are not met, we recommend that the following receiver checks be made.

4.4.6 AGC

a. AGC is directly applied to the base of Q4 and indirectly to the base of Q1.

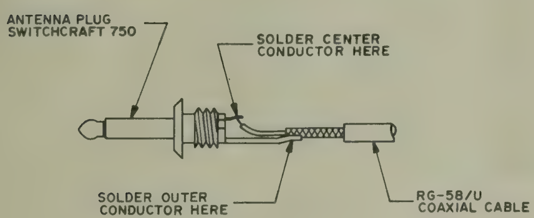
b. AGC problems will cause:

1. The receiver to be completely inoperative.



NOTE 1 A SIGNAL GENERATOR CABLE THAT PLUGS INTO THE 50 OHM ANTENNA JACK MAY BE CONSTRUCTED AS FOLLOWS:

NOTE 2 WE RECOMMEND THAT THE TRANSMITTER CRYSTALS BE REMOVED DURING RECEIVER SERVICING. THIS WILL PROTECT THE SIGNAL GENERATOR IN CASE THE TRANSMITTER IS ACCIDENTLY KEYED.



RECEIVER TEST INSTRUMENT CONNECTIONS
FIGURE 13

2. Overloading at high signal levels.

3. Incorrect bias at the bases of Q1 and Q4.

c. Connect a DC voltmeter between the junction of R15, C26 and B-. See the following chart for typical readings.

AGC VOLTAGE

Conditions: Minimum squelch
6dB pad at generator output
AGC voltage measured at junction R15 and C26

RF input Voltage (μV into 6 dB Pad)	AGC Voltage (VDC)
1	+3
3	+2.75
10	+2.25
30	+1.85
100	+1.6
300	+1.45
1,000	+1.40
3,000	+1.3
10,000	+1.25
100,000	+0.5

4.4.7 SQUELCH CIRCUIT

a. Connect a DC voltmeter between the base of Q7 and B-.

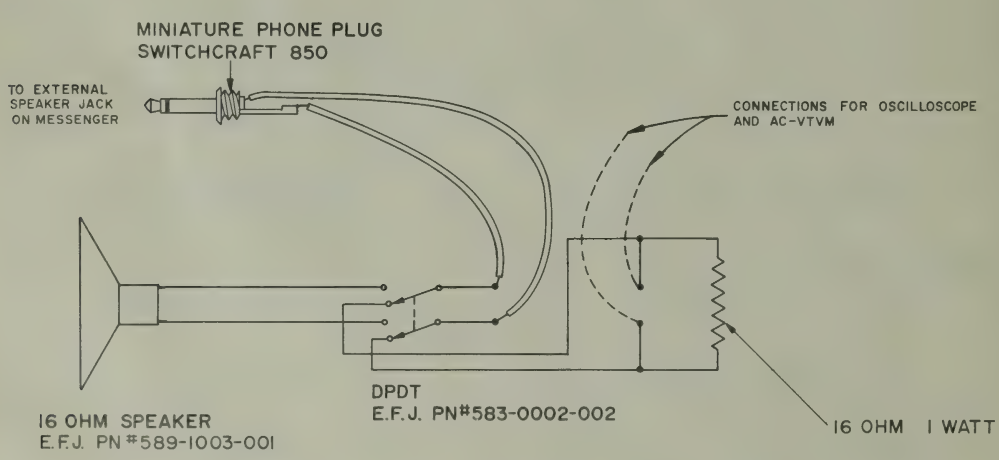
b. While monitoring the DC voltmeter, rotate the squelch control from minimum to maximum.

The typical voltage should change from approximately 0.04 (not squelched) to 0.6 (squelched).

c. If the typical voltage range was not obtained in step b, perform the measurements list in the following chart.

SQUELCH VOLTAGE

Conditions: Measured at the base of Q7
6dB pad at generator output
Squelch control set at maximum (fully closed squelch)



SPEAKER LOAD FOR RECEIVER SERVICING
FIGURE 14

RF Input Voltage (μV into 6 dB Pad)	Squelch Voltage
1	+0.5 Volts
3	+0.475
10	+0.35
30	+0.19
100	+0.1
300	+0.05
1,000	+0.05
10,000	+0.035

d. If the voltage does not change at Q7, check the bias at Q1. If Q1 reads normal, remove Q7 and check it by performing the measurements outlined in Section 4.1.

4.4.8 AUDIO (See Section 4.4.10)

4.4.9 IF (See Section 4.4.10)

4.4.10 INJECTION LEVELS

Tests Conditions: 0.02 μF capacitor used between signal generator coaxial cable and test points. Audio measured across speaker load.

INPUT FREQ.	SIGNAL INJECTOR POINT	SIGNAL INPUT LEVEL AVERAGE LEVEL	AUDIO OUTPUT
27 MHz	Ant. Termin.	0.5 μV	0.8 V
27 MHz	Q1 Base	1.4 μV	0.8 V
455 kHz	Q1 Collect	0.05 V	0.8 V
455 kHz	Q2 Base	17 μV	0.8 V
455 kHz	Q2 Collect	0.01 V	0.8 V
455 kHz	Q4 Base	500 μV	0.8 V
455 kHz	Q4 Collect	0.015 V	0.8 V
455 kHz	Q5 Base	0.01 V	0.8 V
455 kHz	Q5 Collect	0.3 V	0.8 V
1000 Hz	Junction D3 & C39	0.03 V	0.8 V
1000 Hz	Q8 Base	0.001 V	0.8 V
1000 Hz	Q8 Collect	0.03 V	0.8 V
1000 Hz	Q9 Base	0.03 V	0.8 V
1000 Hz	Q9 Collect	0.55 V	0.8 V

4.5 TRANSMITTER

4.5.1 TEST INSTRUMENTS REQUIRED

a. (equivalent or superior equipment may be substituted.)
Regulated DC Power Supply, 13.8 volts 0.5 amperes. Hewlett-Packard 6201A.

b. Oscilloscope - with RF pickup loop capable of direct connection to the vertical plates, see Figure 16.

c. 0.5 ampere DC meter

d. 50 ohm transmitter load with a power rating of at least 3 watts

e. Audio generator - Heath IG-72 or equivalent

4.5.2 TEST INSTRUMENT CONNECTIONS

a. Connect the equipment as shown in Figure 15. Be sure to connect the 50 ohm dummy load.

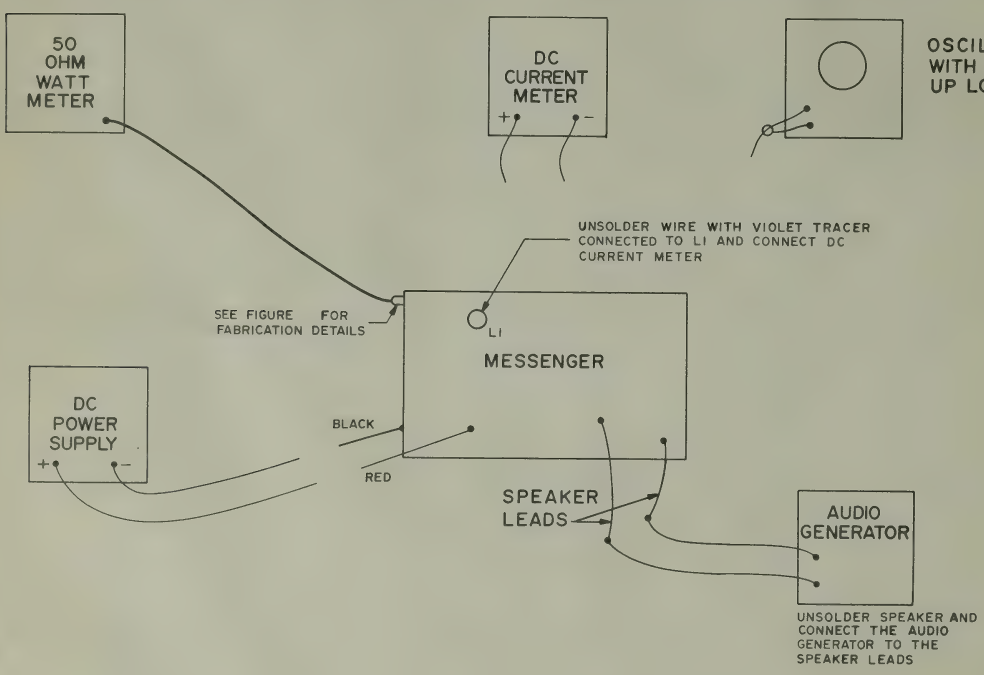
b. Couple the RF pickup loop from the oscilloscope to L3 of the power amplifier stage.

c. Connect the DC power supply. Turn the transceiver on.

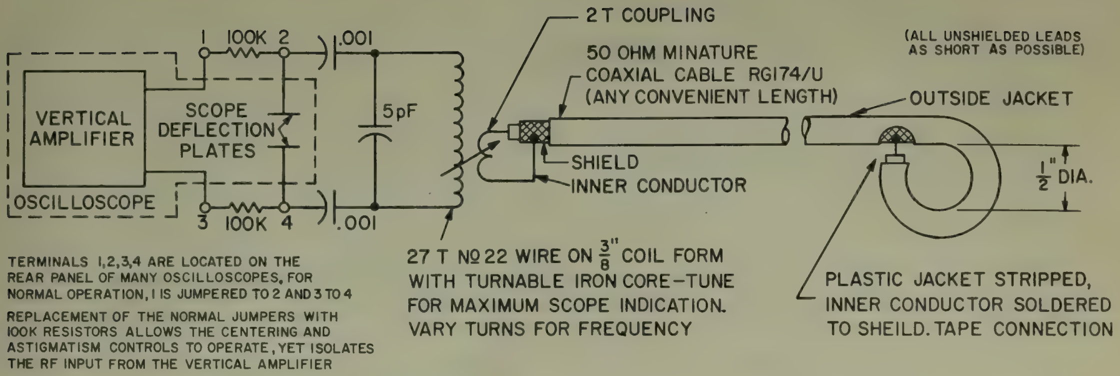
4.5.3 PRELIMINARY TRANSMITTER CHECK

a. Key the transmitter and check for an RF power output of 1.5 watts minimum.

b. Apply a 1000 Hz audio tone to the speaker terminals and monitor the output waveform



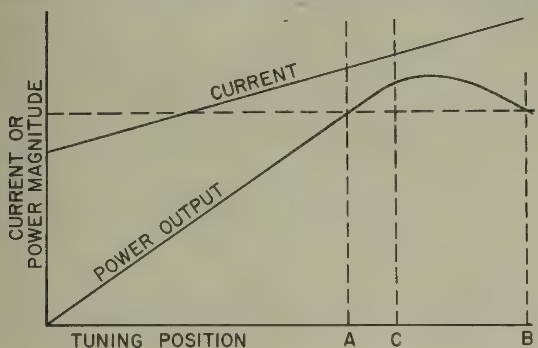
TRANSMITTER TEST INSTRUMENT CONNECTIONS
FIGURE 15



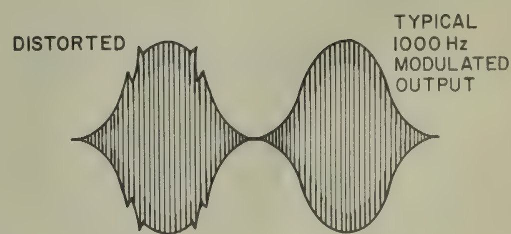
OSCILLOSCOPE RF PICK-UP LOOP
AND METHOD OF CONNECTION
FIGURE 16

on the oscilloscope using the RF pickup loop shown in Figure 16. The output should be a clean modulated RF waveform. If the results of the measurements indicate a defective transmitter continue with the following troubleshooting procedures.

c. When the transmitter output is peaked to normal, modulate carrier with 0.01 volts, 1000 Hz sine wave for 50% upward modulation and check for distortion. (See Figure 18.) If distortion is present, or normal transmitter output cannot be obtained, proceed with the troubleshooting and alignment instructions.



TRANSMITTER
CURRENT-POWER CURVE
FIGURE 17



MODULATED R F WAVEFORM DISTORTION
FIGURE 18

4.5.4 INITIAL TRANSMITTER ADJUSTMENTS

a. Refer to the Alignment Section

b. If the transmitter output is low, change the transmitter current with L2, and peak the power output with L3 to obtain desired power point as shown in Figure 17.

4.5.5 OSCILLATOR STAGE (Q12)

a. Key the transmitter and check for normal power output.

b. If the transmitter is inoperative, check the oscillator stage using the scope and RF pick-up loop. A tunable receiver may also be used to make a quick check of the oscillator. If no RF is present, check the bias of Q12. Also check the crystal.

4.5.6 DRIVER STAGE (Q13)

a. Key the transmitter; if power output is low, adjust T13 and check the driver stage with an RF pickup loop and oscilloscope, (Figure 16).

b. If the RF is low at this point, check the bias of Q13.

4.5.7 POWER AMPLIFIER STAGE

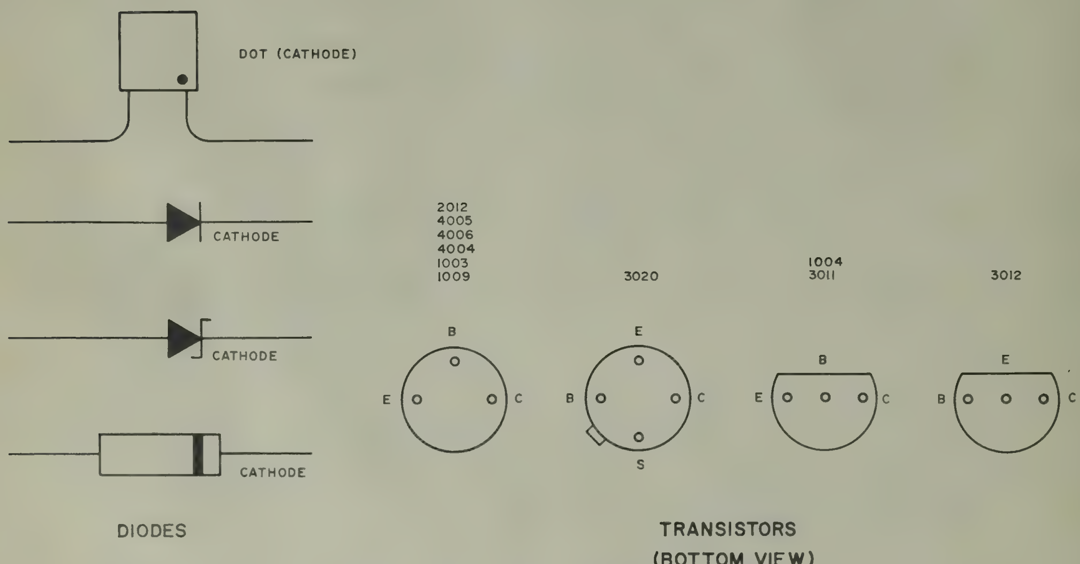
a. Key transmitter - normal power output is approximately 1.6 watts minimum.

b. If tuning does not affect output power, and the driver stage is normal, check the bias of Q14.

4.6 RESISTANCE MEASUREMENTS

Transformer T10 (audio driver)

Winding lead	DC Resistance
Primary 4 to 5	300 ohms maximum
Secondary 1 to 3	45 ohms maximum

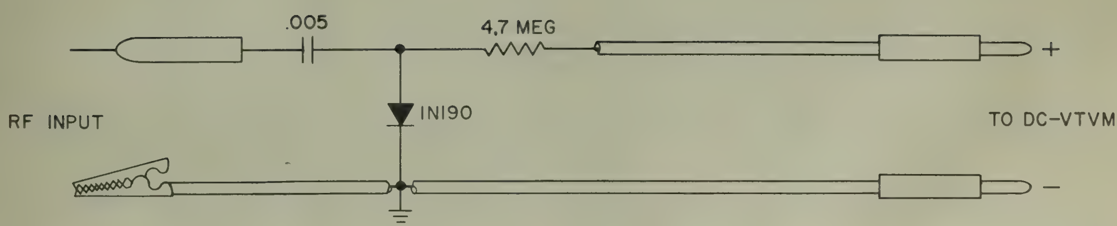


SEMICONDUCTOR CASE DIAGRAMS
BOTTOM VIEWS
FIGURE 19

Transformer T11 (audio output modulation)

Winding lead	DC Resistance
Primary T.C.W. to T.C.W.	6 ohms maximum
Secondary #1, 4 to 5	2 ohms maximum
Secondary #2, Green to T.C.W.	2 ohms maximum

NOTE: T.C.W. is tinned copper wire



CONNECTIONS SHOULD BE MADE AS SHORT AS POSSIBLE TO AVOID STRAY CAPACITANCE WHICH WILL AFFECT THE FREQUENCY RESPONSE OF THE PROBE

THE MAXIMUM INPUT MUST NOT EXCEED 30 VOLTS OF RF. THE OUTPUT OF THE PROBE IS NEGATIVE DC AND THE VTVM FUNCTION SHOULD BE SET ACCORDINGLY

RF PROBE FOR DC-VTVM
FIGURE 20

SECTION 5
ALIGNMENT

5.1 GENERAL

The Messenger transceiver is carefully aligned at the factory. Alignment should be performed by technicians familiar with transistorized transceivers, and who have the necessary test instruments. The following information is a guide for alignment. Refer to Figure 21 for Alignment Points.

5.2 TUNING TOOLS REQUIRED

a. Radio Industries Peaker Tool - XA0378 or equivalent.

b. General Cement - 8606 - hex. tuning tool or equivalent.

c. General Instrument - #10 K

5.3 TEST INSTRUMENTS REQUIRED

Type	Required Characteristics	Use	Recommended Model
VTVM	A low range of 0-1.5 volts on AC and DC	Measure RF, AF and DC Voltages	Heath IM-11 with RF probe or equivalent.
DC Current Meter	Measure from 0 to 1 ampere	Measure current drain.	Triplett 630 or equivalent.
DC Power Supply	0-1 amperes 0-15 volts DC	Provide supply voltage during servicing.	Hewlett-Packard 6201A or equivalent. (Fully charged battery may be used.)
Oscilloscope with RF Pickup Loop	Direct connection to vertical plates. See Figure 16.	Check modulated waveform.	Heath IO-12 or equivalent.
Power Meter	50 ohms, 3 watts	Load for transmitter.	Bird Model 43 or equivalent.
AC-VTVM	-40 db to +10 db	Measure audio	Heathkit IM-21
Audio Generator	1 volt output 1000 Hz	Check audio amps. Modulate transmitter.	Heathkit Model IG-72
Signal Generator	1μV to 1 volt output calibrated. 30% mod at 1000 Hz	Receiver RF source	Hewlett Packard 606 or equivalent

5.4 RECEIVER ALIGNMENT

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
	NOTE: Crystals for channels 1 and 12 should be installed if complete alignment is to be accomplished. Otherwise, the customer's crystals may be used for alignment.	
	a. Connect the RF signal generator to the external 50 ohm antenna jack. See Figure 13 for antenna connector fabrication.	
	b. Connect a speaker load to the external speaker jack. See Figure 14 for speaker load.	NOTE: Refer to Figure 21 for identification of alignment points.
Oscillator (T3)	a. Connect VTVM to the emitter of Q2 (See Figure 20 for RF probe).	Adjust T3 by starting with the slug at the top of the coil and tune through the peak RF reading to 0.125 ±0.025 volts RF on the emitter of Q2. Check for starting and uniform injection voltage on channels 1, 12 and 21 if crystals are available.
IF Section	a. Set the output level of the RF signal generator to 10,000 μV, modulated 30% at 1000 Hz.	
	b. Connect an AC-VTVM across the speaker load.	Peak T9, T8, T7, T6, T5 and T4 for maximum output as viewed on the VTVM. Use as low an input signal as convenient (one that produces about 10 dB signal to noise ratio).
RF Section		Peak T1 and T2 for maximum indication on the audio VTVM. Once a clean signal can be observed on the oscilloscope no peak will be apparent when adjusting T1. Readjust volume as necessary.
	a. Reduce the signal generator to 1 μV modulated at 30%, 1000 Hz.	
	b. Check the receiver gain on channels 1, 12 and 21 if crystals are available. Otherwise, check the receiver gain using customer crystals.	Adjust T1 and T2 for uniform gain and signal to noise ratio. Gain should be within ±6 dB on both channels.

SECTION 5
ALIGNMENT

5.1 GENERAL

The Messenger transceiver is carefully aligned at the factory. Alignment should be performed by technicians familiar with transistorized transceivers, and who have the necessary test instruments. The following information is a guide for alignment. Refer to Figure 21 for Alignment Points.

5.2 TUNING TOOLS REQUIRED

a. Radio Industries Peaker Tool - XA0378 or equivalent.

b. General Cement - 8606 - hex. tuning tool or equivalent.

c. General Instrument - #10 K

5.3 TEST INSTRUMENTS REQUIRED

Type	Required Characteristics	Use	Recommended Model
VTVM	A low range of 0-1.5 volts on AC and DC	Measure RF, AF and DC Voltages	Heath IM-11 with RF probe or equivalent.
DC Current Meter	Measure from 0 to 1 ampere	Measure current drain.	Triplett 630 or equivalent.
DC Power Supply	0-1 amperes 0-15 volts DC	Provide supply voltage during servicing.	Hewlett-Packard 6201A or equivalent. (Fully charged battery may be used.)
Oscilloscope with RF Pickup Loop	Direct connection to vertical plates. See Figure 16.	Check modulated waveform.	Heath IO-12 or equivalent.
Power Meter	50 ohms, 3 watts	Load for transmitter.	Bird Model 43 or equivalent.
AC-VTVM	-40 db to +10 db	Measure audio	Heathkit IM-21
Audio Generator	1 volt output 1000 Hz	Check audio amps. Modulate transmitter.	Heathkit Model IG-72
Signal Generator	1μV to 1 volt output calibrated. 30% mod at 1000 Hz	Receiver RF source	Hewlett Packard 606 or equivalent

5.4 RECEIVER ALIGNMENT

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
	NOTE: Crystals for channels 1 and 12 should be installed if complete alignment is to be accomplished. Otherwise, the customer's crystals may be used for alignment.	
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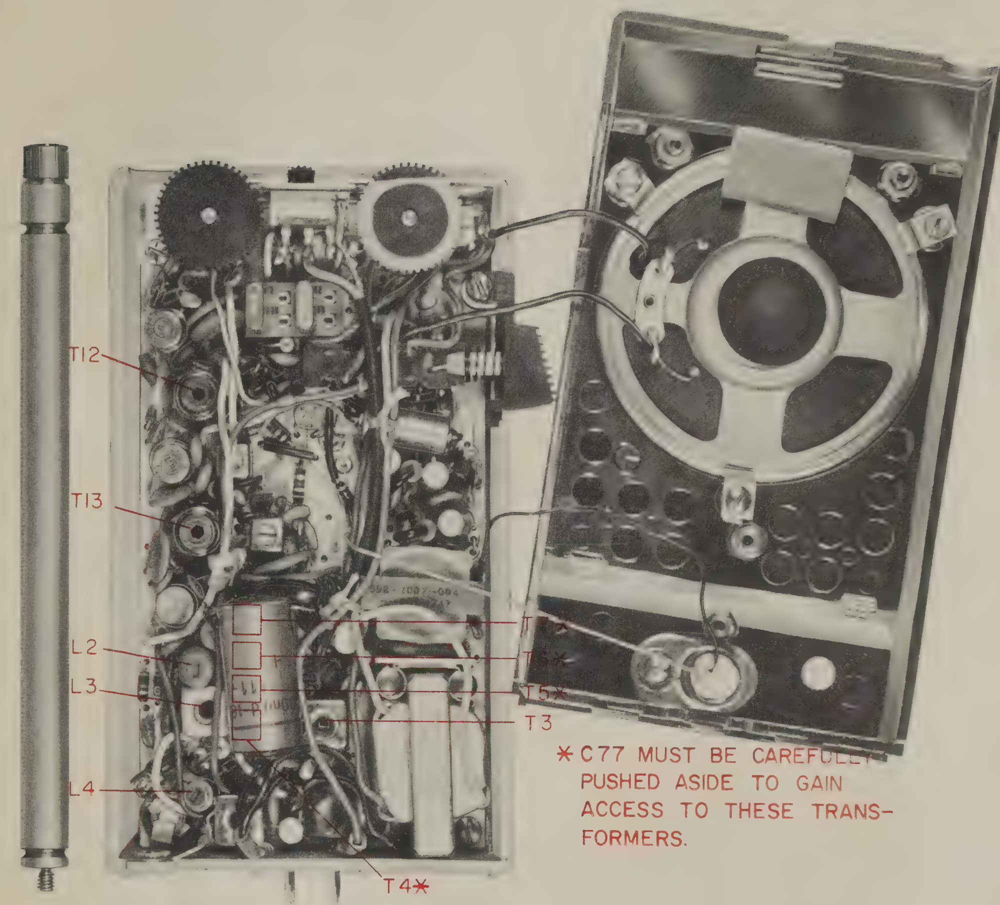
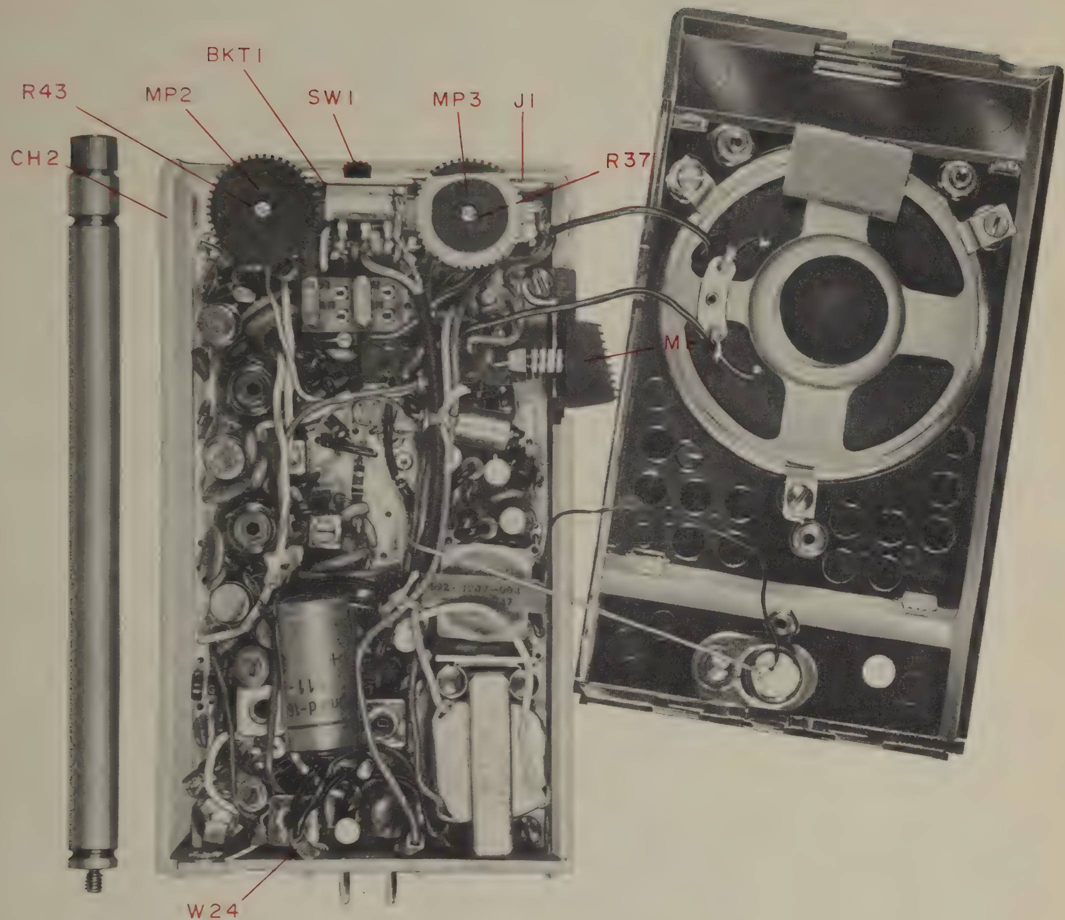
IF Section	a. Set the output level of the RF signal generator to 10,000 μV, modulated 30% at 1000 Hz.	
	b. Connect an AC-VTVM across the speaker load.	Peak T9, T8, T7, T6, T5 and T4 for maximum output as viewed on the VTVM. Use as low an input signal as convenient (one that produces about 10 dB signal to noise ratio).
RF Section		Peak T1 and T2 for maximum indication on the audio VTVM. Once a clean signal can be observed on the oscilloscope no peak will be apparent when adjusting T1. Readjust volume as necessary.
	a. Reduce the signal generator to 1 μV modulated at 30%, 1000 Hz.	
	b. Check the receiver gain on channels 1, 12 and 21 if crystals are available. Otherwise, check the receiver gain using customer crystals.	Adjust T1 and T2 for uniform gain and signal to noise ratio. Gain should be within ±6 dB on both channels.

FOLD OUT →



ALIGNMENT POINTS
FIGURE 21



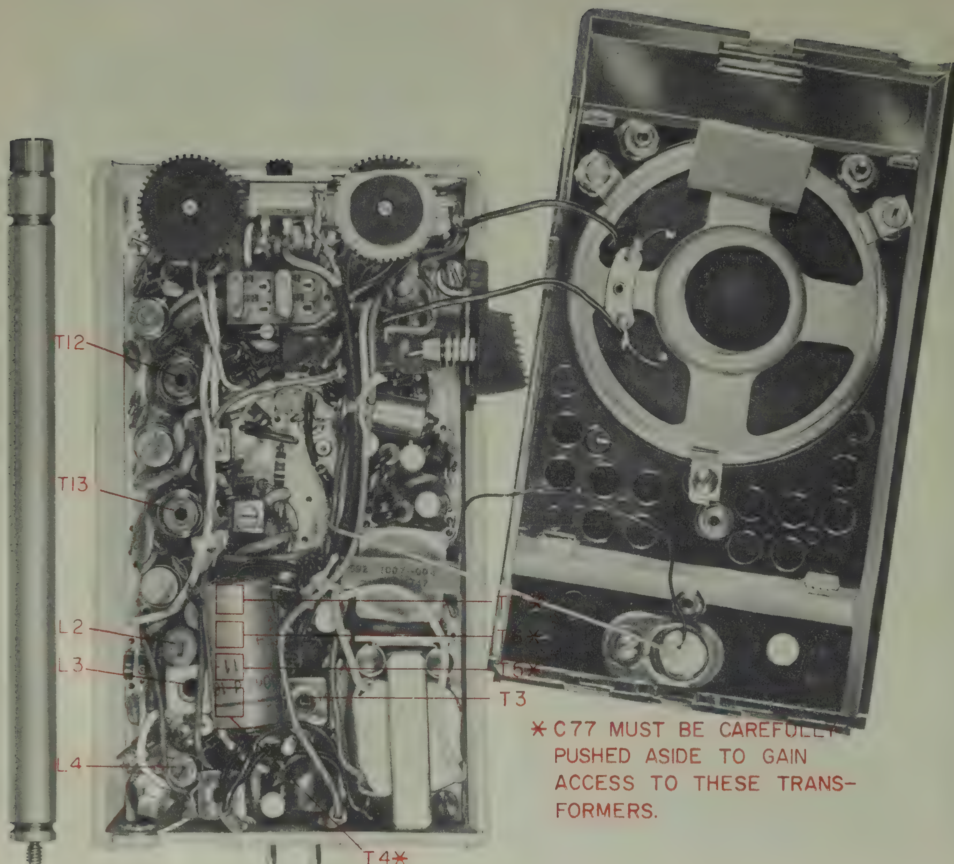
TOP VIEW SHOWING PARTS
NOT CALLED OUT ON TRANSPARENCY
FIGURE 22

ALIGNMENT (cont'd)

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
AGC Roll-off	a. Reset RF signal generator level to 1000 μV 30% modulated at 1000 Hz and adjust the volume control for an indication of 0 dB on the audio VTVM.	
	b. Turn the RF signal generator level back to 1 μV.	Adjust R16 for a drop of 20 ±3 dB on the audio VTVM. Repeat steps a and b. Recheck the setting of R16.
Signal plus noise to noise ratio test	a. Set signal generator to 1 μV modulated 30% with 1000 Hz.	
	b. Increase the volume control to maximum. The audio VTVM should read +5 dB minimum.	
	c. Readjust the volume control for a 0 dB indication on the audio VTVM.	
	d. Turn the signal generator modulation off.	
	e. A drop of 8 dB or more should be observed on the audio VTVM.	
Squelch test	a. Set the signal generator to 5 μV, 30% 1000 Hz.	
	b. Turn the squelch control fully clockwise. The signal should disappear. Receiver audio should be squelched off.	
	c. Reset the signal generator 100 μV. The signal should become audible.	

5.5 TRANSMITTER ALIGNMENT

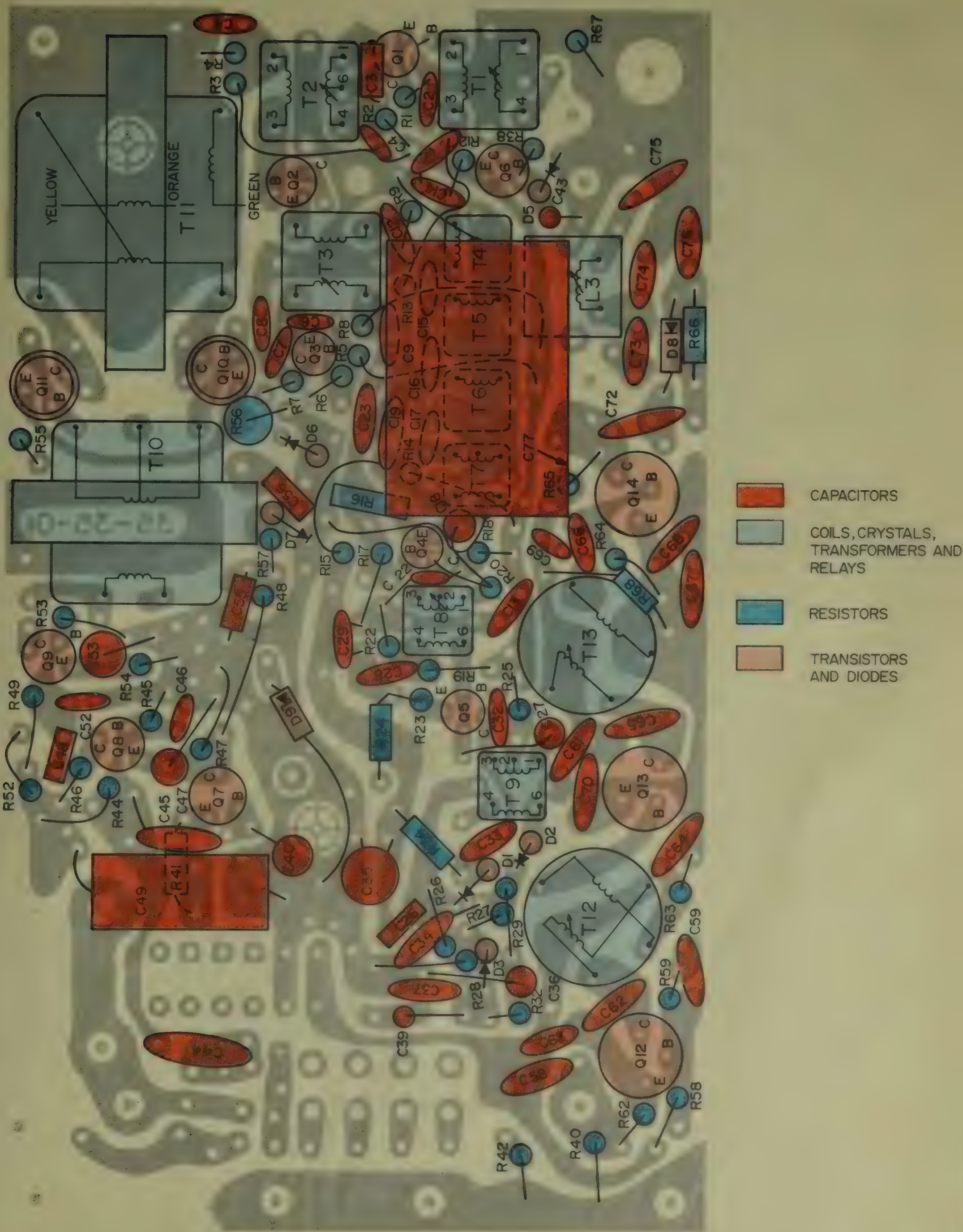
ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
	a. See Figure 15 for transmitter test setup. b. See Figure 21 for transmitter alignment points.	
Power Amplifier (L3, T13)	Key the transmitter.	a. Adjust L3 for peak power output. b. Readjust L3 for 240 mA. c. Adjust T13 for maximum power output and best efficiency. Refer to Figure 17.
Oscillator (T12)	Key the transmitter	a. Adjust T12 for oscillator starting on both channels and absence of distortion (see Figure 18) during modulation. b. The power output should be 1.6 watts minimum (be sure the oscilloscope RF loop is not affecting this reading). c. Record total current of unmodulated carrier for later use.
	a. Increase the audio generator output and observe the oscilloscope for distortion.	
	b. 50% modulation should occur at -38 dB input. Increase the output of the audio generator an additional 20 dB. Check for normal waveform and modulation percentage (70% minimum upward for 80% downward).	If distortion occurs readjust T12 or T13 to eliminate it.
	Final Check: a. Switch between channels. b. Check for normal oscillator starting, clean modulation and absence of oscillation.	



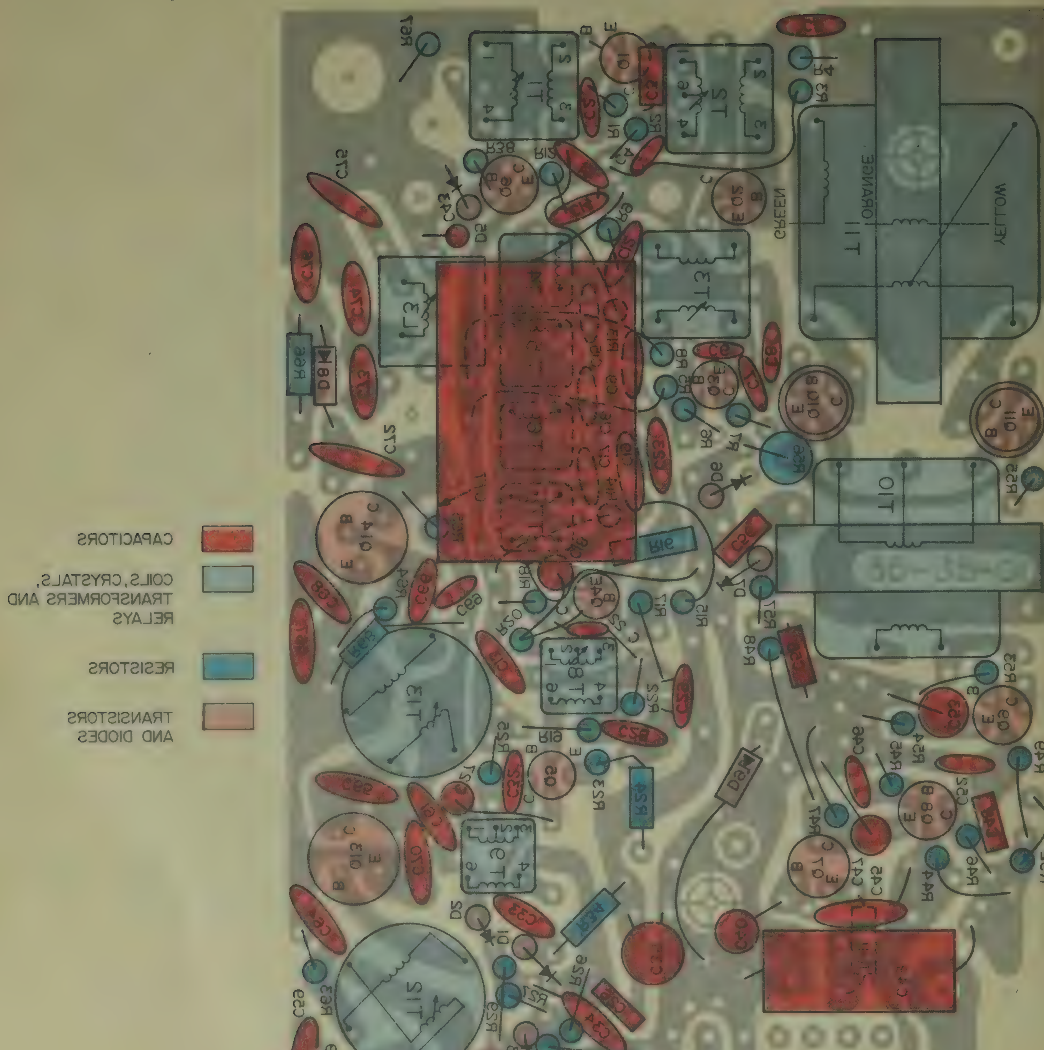
ALIGNMENT POINTS
FIGURE 21

5.5 TRANSMITTER ALIGNMENT

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
	a. See Figure 15 for transmitter test setup. b. See Figure 21 for transmitter alignment points.	
Power Amplifier (L3, T13)	Key the transmitter.	a. Adjust L3 for peak power output. b. Readjust L3 for 240 mA. c. Adjust T13 for maximum power output and best efficiency. Refer to Figure 17.
Oscillator (T12)	Key the transmitter	a. Adjust T12 for oscillator starting on both channels and absence of distortion (see Figure 18) during modulation. b. The power output should be 1.6 watts minimum (be sure the oscilloscope RF loop is not affecting this reading). c. Record total current of unmodulated carrier for later use.
	a. Increase the audio generator output and observe the oscilloscope for distortion.	
	b. 50% modulation should occur at -38 dB input. Increase the output of the audio generator an additional 20 dB. Check for normal waveform and modulation percentage (70% minimum upward for 80% downward).	If distortion occurs readjust T12 or T13 to eliminate it.
	Final Check: a. Switch between channels. b. Check for normal oscillator starting, clean modulation and absence of oscillation.	



MESSENGER 109 PRINTED CIRCUIT BOARD



MESSENGER 109 PRINTED CIRCUIT BOARD

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
	c. Connect a 180 μF mica capacitor across the 50 ohm load at the Messenger 109 antenna connector. d. Check and adjust as necessary to eliminate distortion. e. The power output and current should go downward. f. Disconnect the capacitor and check for normal operation on a 50 ohm load.	

5.6 WHIP ANTENNA TUNING

	1. Remove the recharging circuit board from the battery pack. 2. Unsolder the red "hot" wire from the power terminal. 3. Tack a four inch wire on the power terminal and bring both wires to the side and out of the battery pack. 4. Screw the recharging circuit board down on the battery pack enclosure. 5. Connect a 0.5 DC ammeter between the two protruding wires.	
L4	b. Install everything in the case and connect the battery pack. c. Fully extend the whip antenna. d. Key the transmitter. a. Collapse the whip antenna to one half full length. b. Key the transmitter. The current should drop.	a. Carefully remove the overlay located at the front center of the transceiver. Tune L4 through the hole in the front of the case for the same total transmit current as in step c of the adjustment of T12. NOTE: There may be several peaks. Use the peak with the slug farthest out of the coil.

SECTION 6

PARTS LIST

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	WHIP ANTENNA	
ANT1	Antenna	022-1793-001
	Bushing (required with the above antenna)	032-0182-001
	BRACKET	
BKT1	Mounting bracket assembly, component, includes:	023-2404-001
	Mounting bracket	017-1470-001
	Slide switch (SW1)	583-3003-001
	Rivet	031-0180-003
	Flatwasher	029-0075-001
	Speaker jack ext. (J1)	515-2002-002
	Pot. 10K Ω W/SPST switch (R37)	562-0018-002
	Pot. 5K Ω (R43)	562-0018-001
	Hex nut 1/4-32	012-0098-003
	Lockwasher, internal tooth	029-0410-003
BKT3	Meter and bracket assembly includes:	023-2405-001
	Meter	554-0010-001
	Bracket	016-1674-001
BKT4	Mounting bracket, speaker	017-0534-001
BKT5	Mounting bracket, speaker	017-0534-002
	CAPACITORS	
C1	0.001 μF ±10%	510-3160-102
C2	0.0047 μF ±20%	510-3002-472
C3	27 pF ±5% N150	510-3163-270
C4	0.001 μF ±10%	510-3160-102
C5	0.0047 μF ±20%	510-3002-472
C6	3.9 ±.5 pF NPO	510-3162-399
C7	27 pF ±5% N150	510-3163-270
C8	330 pF ±10%	510-3160-331
C9	0.0047 μF ±20%	510-3002-472
C12	0.22 μF +80% -20% 3V	510-3009-224
C13	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C14	0.0047 μF ±20%	510-3002-472
C15	2.2 ±.5 pF, P-100	510-3161-229
C16	Same as C15	
C17	Same as C15	
C18	1 pF ±5%, 500 volt	510-9002-109
C19	0.047 μF ±20%, Y5S	510-3007-473

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
C22	0.047 μF ±20%, Y5S	510-3007-473
C23	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C26	5.6 μF ±20%, 15 V	510-2023-569
C27	1 pF ±5%, 500 volt	510-9002-109
C28	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C29	Same as C28	
C32	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C33	150 pF ±5%, 100 V	510-0002-151
C34	0.047 μF ±20%, Y5S	510-3007-473
C35	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C36	1 μF ±20%, 35 V	510-2005-109
C37	0.022 μF +80% -20%, Y5S	510-3007-223
C39	1 μF ±20%, 35 V	510-2005-109
C40	0.001 μF ±10%	510-3160-102
C43	5.6 μF ±20%, 35 volt	510-2005-569
C44	0.047 μF ±20%, Y5S	510-3007-473
C45	0.047 μF +80% -20%, Y5S	510-3007-473
C46	0.01 μF +80% -20%, 16 V Y5S	510-3007-103
C47	22 μF, 15 V	510-2003-220
C48	5.6 μF ±20%, 15 V	510-2023-569
C49	50 μF, 25 V	510-4008-006
C52	0.022 μF +80% -20%, Y5S	510-3007-223
C53	68 μF, 10V	510-2045-680
C55	1 μF ±20%, 35 V	510-2025-109
C56	0.22 μF ±10%	510-2033-228
C57	0.33 μF ±20%, 50 V Y5V	510-3051-334
C58	0.047 μF ±20% Y5S	510-3007-473
C59	22 pF ±5%, N750	510-3020-220
C61	0.0047 μF ±20%	510-3002-472
C62	22 pF ±5%, N750	510-3020-220
C63	150 pF ±5%, N750	510-3020-151
C64	0.001 μF ±20%	510-3002-102

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
C65	43 pF ±5%, N150, 200V	510-3016-430
C66	0.001 μF ±20%	510-3002-102
C67	0.047 μF ±20% Y5S	510-3007-473
C68	0.0022 μF	510-3002-222
C69	0.0047 μF ±20%	510-3002-502
C70	Same as C69	
C72	43 pF ±5%, N150, 200V	510-3016-430
C73	68 pF ±5%, 100 V	510-0002-680
C74	560 pF ±5%, 100 V	510-0001-561
C75	510 pF ±5%, 100 V	510-0001-511
C76	0.001 μF ±20%	510-3002-102
C77	1000 μF +100 -10%, 16 V	510-4006-005
C78	200 pF ±5%, 100 V	510-0002-201
	CASE	
CH1	Front, includes:	023-2343-001
	Case front	032-0166-001
	Speaker grille	017-0529-001
	Overlay, upper	559-2021-001
	Medallion	559-0027-001
	Overlay, lower	559-2022-001
	Grille cloth	018-0862-001
CH2	Back, includes:	023-2340-001
	Case back	032-0167-001
	Stake nut	013-1014-001
	Terminal lug	016-0456-001
	Stake nut	013-1014-007
	Banana plug	108-0802-002
	Flatwasher #6	029-0222-001
	Terminal lug	022-0069-003
	DIODES	
D1	1N295	523-1000-295
D2	Same as D1	
D3	1N881	523-1000-881
D5	Zener 10 volt, 400 mW	523-2005-100
D6	1N2326	523-1002-326
D7	1N881	523-1000-881
D8	Same as D7	
D9	Zener 10 volt, 400 mW	523-2005-100

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	BUSHING	
E1	Antenna shoulder bushing	032-0182-001
	HEAT SINKS (for Q10 and Q11)	
E2	Heat sink	539-0005-001
	HARDWARE	
	Screw, shoulder (switch button)	013-1133-001
	Nut, hex 1/4 - 32 x 3/8 x 3/32 (antenna jack)	012-0098-003
	Lockwasher, internal tooth, #1/4 (antenna jack)	029-0410-003
	Screw, captive #4-40 x 1 1/4 lg. (case back)	013-1130-002
	Screw, B.H. slotted #4-40 x 3/16 lg. (P.C. board, mtg. bracket)	011-0012-006
	Screw, pan hd. steel CP-#1-72 (control knobs)	011-0824-007
	Screw, flat head, 100° angle, #4-40 x 3/16 lg. (mtg. bracket under antenna)	011-0554-006
	Nut, hex #4-40 (P.C. board to mtg. bracket)	012-0163-003
	Lockwasher, internal tooth #4	029-0116-003
	Screw, R.H. slotted #4-40 x 3/16 lg. (P.C. board to case back)	011-0011-006
	JACKS	
J2	Antenna	515-2001-001
J1	Speaker	515-2002-002
	CHOKES AND COILS	
L1	RF choke, (13 μH)	542-3003-001
L2	* Output series	542-1006-002
L3	* Output Pi	542-1006-001
L4	* Antenna	542-1008-007
	* Cemented to circuit board	
	SPEAKER	
LS	16 ohm includes:	589-1003-001

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	Sponge (attached to under side of speaker)	018-0849-101
M	Battery condition meter, 0-500μA full scale	554-0010-001
	BUTTONS, KNOBS, OVERLAY	
MP1	Button, switch actuator	032-0158-001
MP2	Knob, control	032-0159-001
MP3	Knob, control on-off	032-0159-002
MP4	Overlay, lower	559-2022-001
	TRANSISTORS	
Q1	RF-3020	576-0003-020
Q2	Mixer-3011	576-0003-011
Q3	Oscillator-3011	576-0003-011
Q4	1st IF-3011	576-0003-011
Q5	2nd IF-3011	576-0003-011
Q6	Vol. Reg., 1004	576-0001-004
Q7	Squelch, 2013	576-0002-013
Q8	Audio, 1003	576-0001-003
Q9	Driver, 1009	576-0001-009
Q10	Audio output, 2012	576-0002-012
Q11	Same as Q10	
Q12	Oscillator, 4006	576-0004-006
Q13	* Driver, 4004	576-0004-004
Q14	* Final driver, 4013	576-0004-013
	* Use silicone grease when mounting	
	NOTE: Use only E.F. Johnson replacement transistors.	
	RESISTORS	
R1	2200 Ω ±10%, 1/4 watt	569-1002-222
R2	470 Ω ±10%, 1/4 watt	569-1002-471
R3	12000 Ω ±10%, 1/4 watt	569-1002-123
R4	2200 Ω ±10%, 1/4 watt	569-1002-222
R5	6800 Ω ±10%, 1/4 watt	569-1002-682
R6	1200 Ω ±10%, 1/4 watt	569-1002-122

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
R7	2200 Ω ±10%, 1/4 watt	569-1002-222
R8	Same as R7	
R9	1000 Ω ±10%, 1/4 watt	569-1002-102
R11	22000 Ω ±10%, 1/4 watt	569-1002-223
R12	470 Ω ±10%, 1/4 watt	569-1002-471
R13	1000 Ω ±10%, 1/4 watt	569-1002-102
R14	82000 Ω ±10%, 1/4 watt	569-1002-823
R15	1000 Ω ±10%, 1/4 watt	569-1002-102
R16	Potentiometer, 470 Ω	562-0019-471
R17	1000 Ω ±10%, 1/4 watt	569-1002-102
R18	470 Ω ±10%, 1/4 watt	569-1002-471
R19	12000 Ω ±10%, 1/4 watt	569-1002-123
R20	75,000 Ω ±5%, 1/4 watt	569-1001-753
R22	2200 Ω ±10%, 1/4 watt	569-1002-222
R23	47 Ω ±10%, 1/4 watt	569-1002-470
R24	470 Ω ±10%, 1/4 watt	569-1002-471
R25	Same as R24	
R26	75,000 Ω ±5%, 1/4 watt	569-1001-753
R27	5600 Ω ±10%, 1/4 watt	569-1002-562
R28	Thermistor 12000 Ω	023-2042-005
R29	15,000 Ω ±10%, 1/4 watt	569-1002-153
R32	10000 Ω ±10%, 1/4 watt	569-1002-103
R34	56,000 Ω ±10%, 1/4 watt	569-1002-563
R37	Potentiometer, 10K, with SPST SW.	562-0018-002
R38	15,000 Ω ±10%, 1/4 watt	569-1002-153
R39	3300 Ω ±10%, 1/4 watt	569-1002-332
R40	220 Ω ±10%, 1/4 watt	569-1002-221
R41	100 Ω ±10%, 1/4 watt	569-1002-101
R42	2200 Ω ±10%, 1/4 watt	569-1002-222
R43	Potentiometer, 5K	562-0018-001
R44	39,000 Ω ±10%, 1/4 watt	569-1002-393
R45	10000 Ω ±10%, 1/4 watt	569-1002-103
R46	680 Ω ±10%, 1/4 watt	569-1002-681

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
R47	3900 Ω ±10%, 1/4 watt	569-1002-392
R48	6800 Ω ±10%, 1/4 watt	569-1002-682
R49	33,000 Ω ±10%, 1/4 watt	569-1002-333
R52	470 Ω ±10%, 1/4 watt	569-1002-471
R53	2700 Ω ±10%, 1/4 watt	569-1002-272
R54	330 Ω ±10%, 1/4 watt	569-1002-331
R55	4700 Ω ±10%, 1/4 watt	569-1002-472
R56	2.2 Ω ±10%, 1/2 watt, wire-wound	569-2003-229
R57	5600 Ω ±10%, 1/4 watt	569-1002-562
R58	5100 Ω ±5%, 1/4 watt	569-1001-512
R59	510 Ω ±5%, 1/4 watt	569-1001-511
R62	51 Ω ±5%, 1/4 watt	569-1001-510
R63	68 Ω ±10% 1/4 watt	569-1002-680
R64	47 Ω ±10%, 1/4 watt	569-1002-470
R65	10000 Ω ±10%, 1/4 watt	569-1002-103
R66	1000 Ω ±10%, 1/4 watt	569-1002-102
R67	47,000 Ω ±10%, 1/4 watt	569-1002-473
R68	47 Ω ±10%, 1/4 watt	569-1002-470
	SHIELD	
SH1	Coil	578-0002-001
	SWITCHES	
SW1	Channel selector	583-3003-001
SW2	Push-to-talk	583-4003-001
	TRANSFORMERS	
T1	27 MHz input	592-5015-001
T2	27 MHz output	592-5015-002
T3	27 MHz oscillator	592-5015-003
T4	455 kHz bandpass	592-5020-002
T5	Same as T4	
T6	Same as T4	
T7	455 kHz bandpass	592-5020-003
T8	455 kHz IF	592-5020-004
T9	Same as T8	
T10	Audio driver	592-1007-004
T11	Audio output, modulation	592-1017-001
T12	Oscillator	592-5014-001
T13	Driver	592-5014-002
	BATTERY LEADS	
W24	Quick - disconnect (black)	597-0005-005
	CRYSTAL BLOCK	
XY1	4 position	126-0110-101

NOTE:
The value of many components used in Johnson equipment are being changed to coincide with Electronic Industries Association (EIA) standard values. These value changes are being made where performance of the unit is not affected by the change. Orders for a particular part number may be filled with either a new or old value part, depending upon availability.

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.

CRYSTALS

CHANNEL	OPERATING FREQUENCY	Y2 TRANSMITTER CRYSTAL PART NO.	Y1 RECEIVER CRYSTAL PART NO.
1	26.965	519-0011-001	519-0011-301
2	26.975	-002	-302
3	26.985	-003	-303
4	27.005	-004	-304
5	27.015	-005	-305
6	27.025	-006	-306
7	27.035	-007	-307
8	27.055	-008	-308
9	27.065	-009	-309
10	27.075	-010	-310
11	27.085	-011	-311
12	27.105	-012	-312
13	27.115	-013	-313
14	27.125	-014	-314
15	27.135	-015	-315
16	27.155	-016	-316
17	27.165	-017	-317
18	27.175	-018	-318
19	27.185	-019	-319
20	27.205	-020	-320
21	27.215	-021	-321
22	27.225	-022	-322
23	27.255	-023	-323

RECHARGEABLE BATTERY PACK

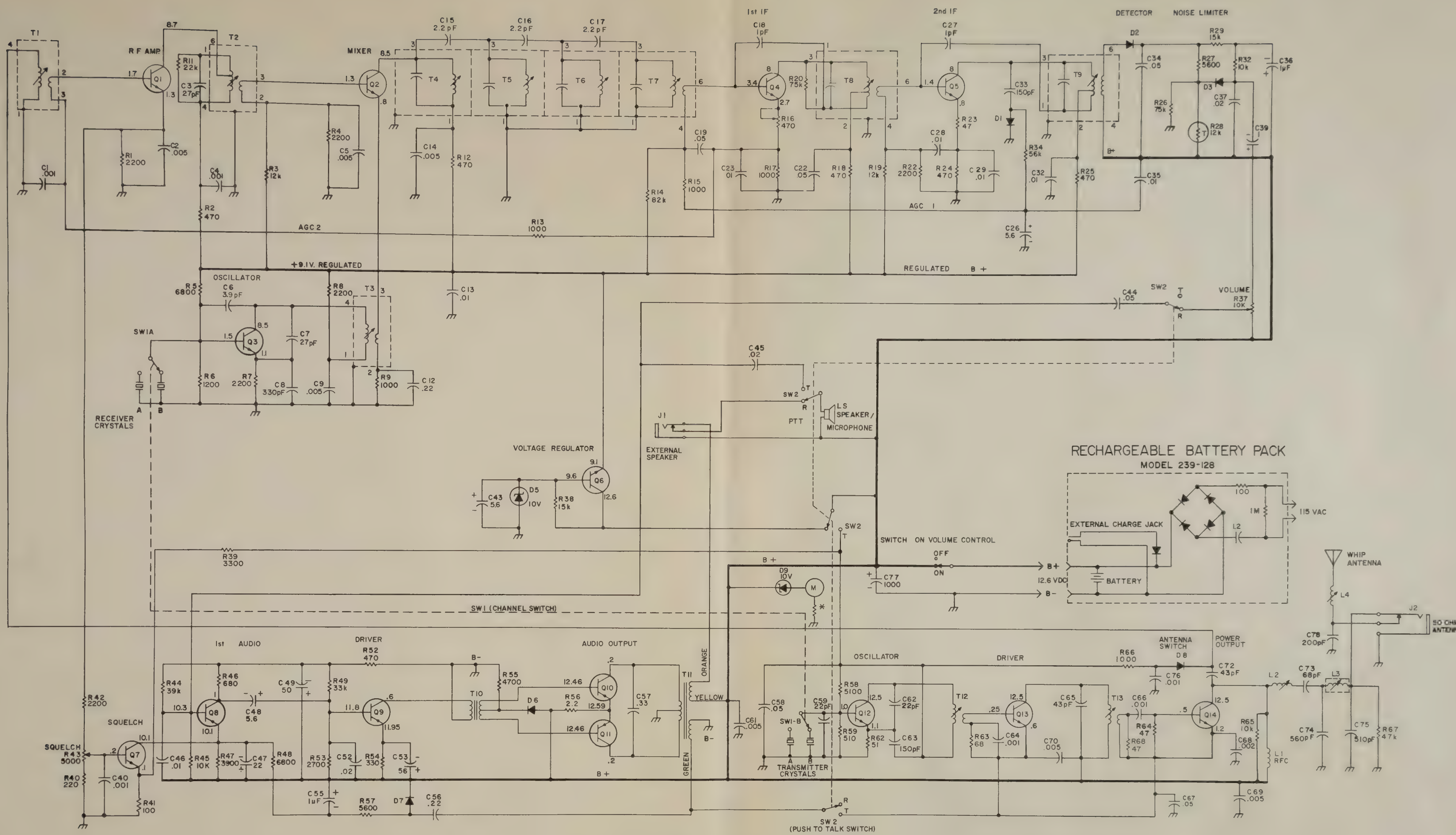
DESCRIPTION	PART NO.
Battery Case	032-0168-001
Rechargeable Circuit includes:	023-2406-001
Header assembly	023-2353-002
Capacitor, 1.2 μF	510-1003-125
Diode	523-1000-881
Resistor, 1 meg	569-1002-105
Bridge rectifier	523-4001-001
Resistor, 100 ohms	569-1002-101
Battery, rechargeable (2)	503-0002-001
Contact assembly	023-2383-001
Scr., R.H., self tap., #2-32	011-0810-010
Screw, Fil Hd. #6-32	013-1130-005
Rubber bumper	018-0798-007
Standoff	013-1134-001
Wire, #22 stranded, black	071-0911-910
Wire, #22 stranded, red	071-0911-902
Instruction label	559-4017-001

ACCESSORY PACKAGE ITEMS

DESCRIPTION	PART NO.
Operating manual	002-0062-001
Part 95 rules - Citizens Radio Service	022-1635-001
FCC Form 505 - License Application form	022-1636-001
Warranty registration card	041-0419-014
Reduced schematic	564-3000-109

SERVICE NOTES

SERVICE NOTES



MESSENGER 109
WITH RECHARGEABLE BATTERY PACK
025-0735-001
3-1-68
MODEL 242-109

NOTES:
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
2. RESISTANCE VALUES ARE IN OHMS
3. VOLTAGES ARE MEASURED WITH VOLUME CONTROL MAXIMUM (CW), SQUELCH AT MINIMUM (CCW), 50 OHM DUMMY LOAD CONNECTED TO J2, POWER SUPPLY 12.6. ALL VOLTAGES MEASURED WITH H.P. 410C.
4. VOLTAGES REFERENCED TO B-.
5. POWER INPUT TO Q14 = $V_{CE} \times I_C$ = 12.5 X .240 = 3 WATTS MAXIMUM.
6. * SELECTED VALUE

QUALITY ELECTRONIC PRODUCTS SINCE 1923

E. F. JOHNSON COMPANY
WASECA, MINNESOTA 56093

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PART NO. 001-0062-001 6-68 Printed in U.S.A.